parameters and defines the number of times of stimulation of each point within one cycle. The simplest example is, for example, as follows.

$$N(i)=\begin{cases} d(i)-\text{threshold} & (d(i)\geq\text{threshold}) \\ 0 & \text{otherwise} \end{cases} \quad \text{[Equation 3]}$$

[0082] The maximum number of stimulations permitted is determined as described above. The parameter (in this example, "threshold") for the stimulation determination function is then adjusted so that the "total number of stimuli" during one cycle does not exceed the maximum number of stimuli.

[0083] To summarize, the electro-tactile presentation apparatus includes an image capture section that captures images, an image processing unit that processes the acquired images, a control unit that generates a tactile presentation signal based on the information obtained by the image processing unit, an electrode array that generates tactile stimuli, and a switching circuit that switches each electrode between a power supply and ground. The control unit further includes a stimulation determination section (constructed from a stimulation determination function) that determines whether or not to carry out electrical stimulation, and a threshold value adjustment section (threshold value control section) that adjusts (controls) a threshold value of the stimulation determination section.

[0084] The threshold value adjustment section changes the threshold value of the stimulation determination function (function determining whether or not to carry out electrical stimulation) so that the number of stimuli occurring in a fixed time period (one cycle) does not exceed a predetermined maximum number of stimuli. It is then possible to ensure a preferred stimulation frequency (for example, at least 30 Hz or more) by suppressing the total number of stimuli.

[0085] An intermediate gradation representation is implemented by increasing the number of times of stimulation at one point. The scanning frequency for all of the stimulation points is fixed at a predetermined frequency or more (for example, 30 Hz or more). It is then possible to represent change in stimulation intensity from (scanning frequency×0) Hz to (scanning frequency×7) Hz by stimulating each stimulation point zero to seven times during this time. The threshold value of the stimulation determination means (stimulation determination function) is adjusted so that the total number of stimuli does not exceed the maximum number of stimuli.

[D-4] Achieving High-Quality for Spatial Feature Extraction

[0086] Currently, processing to enhance spatial edges of a pattern is carried out by extracting edges using a simple Laplacian operator when presenting a two-dimensional pattern. When, for example, a triangular shape is represented, the three edges are extracted and stimulated. However, this is insufficient and in order to improve sensory perception, it is necessary to enhance and stimulate the three "apexes" of the triangular shape (FIG. **10**). In particular, in an environment where artificial objects are common, it is possible to automatically recognize straight lines, circles and ellipses using a "Hough transform" that is a typical image processing method and to obtain apex positions by calculating intersections of recognized lines. The presentation of high-quality sensations is then carried out by using the above technique to recognize apexes and the stimulating in an enhanced manner.

[0087] In particular, when the two-dimensional pattern is an image, extraction of a specific color, a specific brightness, and a specific time-varying change is important in practical terms in the present system. For example, in the case of utilization as sense of sight proxy system for a visually impaired person, by extracting specific colors, specific brightness, and specific time-varying change, it is possible to recognize the color of signals and flashing signals so as to present warnings to the user.

[0088] In addition, information that compares with a sense of sight can be presented using tactile stimulation of a lower spatial resolution compared to a sense of sight by recognizing and storing a specific pattern and representing the specific pattern using change in the type of stimulation. Of specific importance is the incorporation of a module for recognizing people's faces. In this way, the wearer can recognize known or yet-known people in surroundings.

[D-5] Response to Time-Varying Information

[0089] A method for stimulating a time-varying (time differential) location in an enhanced manner simulates Meisner corpuscle activity that is one type of tactile receptor. This leads to the representation of high-quality sensations (FIG. **11**). This itself can also be considered in related research.

[0090] In the present system where a sensor is mounted on a person's head and the forehead is electrically stimulated, the characteristics are that it is important not to react to movement of the whole image. Namely, movement of the image as a whole is eliminated as an offset and only moving parts in the image are extracted. This means that changes to the image that inevitably occur at the forehead-mounted camera as a result of the observer moving their own head around are ignored and that objects moving in an external environment are enhanced (FIG. **12**).

[0091] When cancellation of rotational movement of the head is incorporated, what happens when the head exhibits "translation motion"? At this time, by similarly compensating for movement of the image as a whole, it is possible to extract only objects that are in close proximity using a motion parallax (differences in "seeing" of three-dimensional objects using movement of a viewpoint). By utilizing this effectively, it is possible to acquire the detection of depth using translation movement of the head.

[0092] As described above, a time differential is useful. However, the extent by which each pixel has moved corresponds to "correlation calculations" which require the largest amount of calculations in image processing. In order to suppress the load of the correlation calculation, flow vectors for the images due to rotation of the head are calculated using separate means and overall movement is then subtracted using this information in advance so as to make the size of the integration window used in the correlation arithmetic extremely small (=proportional to the assumed speed of movement). It is therefore possible to dramatically reduce the amount of calculation involved. If a binary output of "moved/didn't move" is simply adopted using a differential, the correlation calculation itself becomes unnecessary (FIG. **14**). A method has been considered where a rotational acceleration sensor that measures head movement is built-in and compensation is performed using this information. Further, it has also been considered to use an artificial retina element with a movement extraction function.